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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/560,555	04/28/2000	David L. Stephenson	15-4-910.00	3306

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EXAMINER
GROSS, KENNETH A

ART UNIT	PAPER NUMBER
2122	12

DATE MAILED: 07/02/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/560,555	STEPHENSON ET AL.	
	Examiner	Art Unit	
	Kenneth A Gross	2122	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Peri d for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 May 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *4* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on May 21st, 2003 has been entered.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claim 1, 6, 9, and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buzbee et al. (U.S. Patent Number 5,815,721) in view of Buzbee et al. (U.S. Patent Number 6,275,981) and further in view of Goebel (U.S. Patent Number 6,139,200).

In regard to Claim 1, Buzbee (U.S. Patent Number 5,815,721) teaches: (1) accessing the first intermediate representation of source code with instrumented instructions. "Annotations are placed in the first object code. The translator utilizes the annotations within the first object code to determine the particular profiling code to be placed within the second object code and thus to determine the profile information which will be generated." (Column 2, lines 20-25); (2) Annotating intermediate code with feedback data as shown in Figure 5, element 42; (3) Updating data using a propagation scheme. This is shown in Figure 5, elements 44-45, where a translator

generates profile information based on annotations; (4) Optimizing intermediate code using feedback data. "Profile information 36 is used during a second compile to produce an optimized application 38. (Column 3, lines 55-56, figure 6); (5) Repeating the updates to the propagation data and the optimization based on this feedback data to further optimize code. The "process my be repeated to generate additional profile information about the optimized object code to further optimize object code for the application." (Column 2, lines 16-18). Buzbee (U.S. Patent Number 5,815,721) does not specifically teach that the feedback data annotated into the intermediate representation is numerical data. Buzbee (U.S. Patent Number 6,275,981) does teach annotating source code with numerical data (Column 2, lines 6-20). Buzbee (U.S. Patent Number 5,815,721) does teach performing multiple optimizations, but neither Buzbee (U.S. Patent Number 5,815,721) nor Buzbee (U.S. Patent Number 6,275,981) teach performing multiple updates and optimizations during the same compilation pass. Gobel, however, does teach performing multiple feedback data updates and optimization in a single compiler pass (Figure 5, items 540 and 570 and Column 8, lines 30-35). Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to access an instrumented source code, annotate it with feedback data, and update the data and perform optimizations of the source code multiple times, as taught by Buzbee (U.S. Patent Number 5,815,721), where the feedback data is numerical as taught by Buzbee (U.S. Patent Number 6,275,981), and the multiple updates and optimizations occur in one compiler pass, as taught by Gobel, since this allows for a fully optimized program on only one compilation. Claims 6 and 14 correspond directly with Claim 1 and are rejected for the same reasons as Claim 1.

In regard to Claim 9, Buzbee (U.S. Patent Number 5,815,721) teaches: (1) accessing the first intermediate representation of source code with instrumented instructions. "Annotations are placed in the first object code. The translator utilizes the annotations within the first object code to determine the particular profiling code to be placed within the second object code and thus to determine the profile information which will be generated." (Column 2, lines 20-25); (2) Annotating intermediate code with feedback data as shown in Figure 5, element 42; (3) Updating data using a propagation scheme. This is shown in Figure 5, elements 44-45, where a translator generates profile information based on annotations; (4) Optimizing intermediate code using feedback data. "Profile information 36 is used during a second compile to produce an optimized application 38. (Column 3, lines 55-56, figure 6); (5) Repeating the updates to the propagation data and the optimization based on this feedback data to further optimize code. The "process my be repeated to generate additional profile information about the optimized object code to further optimize object code for the application." (Column 2, lines 16-18). Buzbee (U.S. Patent Number 5,815,721) does not specifically teach that the feedback data annotated into the intermediate representation is frequency data. Buzbee (U.S. Patent Number 6,275,981), however, does teach collecting frequency data for instructions in the source code (Column 1, lines 43-65). Buzbee (U.S. Patent Number 5,815,721) does teach performing multiple optimizations, but neither Buzbee (U.S. Patent Number 5,815,721) nor Buzbee (U.S. Patent Number 6,275,981) teach performing multiple updates and optimizations during the same compilation pass. Gobel, however, does teach performing multiple feedback data updates and optimization in a single compiler pass (Figure 5, items 540 and 570 and Column 8, lines 30-35). Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to access an

instrumented source code, annotate it with feedback data, and update the data and perform optimizations of the source code multiple times, as taught by Buzbee (U.S. Patent Number 5,815,721), where the feedback data is frequency data as taught by Buzbee (U.S. Patent Number 6,275,981), and the multiple updates and optimizations occur in one compiler pass, as taught by Gobel, since this allows for a fully optimized program on only one compilation.

4. Claims 2, 10, and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buzbee et al. (U.S. Patent Number 5,815,721) in view of Buzbee et al. (U.S. Patent Number 6,275,981) and further in view of Goebel (U.S. Patent Number 6,139,200) and Chaitin (U.S. Patent No. 4,656,582).

In regard to Claim 2, neither Buzbee (U.S. Patent Number 5,815,721) nor Buzbee (U.S. Patent Number 6,275,981) nor Goebel (U.S. Patent Number 6,139,200) specify if dead code elimination, dead store elimination, branch elimination, or code transformation optimizations are preformed. However, the Chaitin reference teaches a method of optimizing compiled code using dead code elimination. (Column 9, line 40) Chaitin calls dead code elimination a "standard technique." Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use the optimization method outlined by Buzbee wherein the method uses dead code elimination, since it is a standard and beneficial technique for optimization. Claims 10 and 15 correspond with Claim 2 and are rejected for the same reasons as Claim 2.

5. Claims 3, 7, 11, and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buzbee et al. (U.S. Patent Number 5,815,721) in view of Buzbee et al. (U.S. Patent Number 6,275,981) and further in view of Goebel (U.S. Patent Number 6,139,200) and Robert Morgan, "Building an Optimizing Compiler" (hereinafter Morgan).

In regard to Claim 3, neither Buzbee (U.S. Patent Number 5,815,721) nor Buzbee (U.S. Patent Number 6,275,981) nor Goebel (U.S. Patent Number 6,139,200) mentions that the second source code (or intermediate representation) should be represented a tree corresponding to procedures within the source code. However, Morgan teaches in Chapter 4, Section 1 (page 94) that "Optimizing compilers use a range of different data structures to represent procedures being compiled...the procedure may be represented as a tree...it is natural to represent the procedure as a tree." See abstract syntax trees in Section 4.1 for representing procedures. Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use the optimization method outlined by Buzbee wherein the intermediate representation of the source code would be a tree structure as taught by Morgan, since a tree representation allows for easier access to parsed data. Claims 7, 11, and 13 correspond with Claim 3 and are rejected for the same reasons as Claim 3.

6. Claims 4, 5, 8, 12, 13, 17, and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buzbee et al. (U.S. Patent Number 5,815,721) in view of Buzbee et al. (U.S. Patent Number 6,275,981) and further in view of Goebel (U.S. Patent Number 6,139,200), Robert Morgan, "Building an Optimizing Compiler" (hereinafter Morgan) and Larus (U.S. Patent Number 6,327,699).

In regard to Claim 4, as applied to Claim 3 above, the combination of Buzbee and Morgan does not teach the conversion from a tree to a control flow graph and the annotation of frequency values to said control graph as described by applicant in Claim 4. However, the Larus reference does teach the conversion of a program into a control flow graph, which profiles the entire path of a program. Larus describes a method that instruments a program with code and

then executes the program in order to trace the entire path of the program. Furthermore, Larus teaches that the control flow graph would collect metrics as it profiles the program path, one such metric being the frequency of the execution of a program path. (Claims 1, 6, 7 of Larus) Since it is beneficial to represent source code as a tree, it would have been apparent to convert a tree into a control flow diagram, deriving the benefits from the tree representation. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to construct an optimizing compiler taught by Buzbee wherein the intermediate representation of the source code would be a tree structure as taught by Morgan, since a tree representation allows for easier access to parse data. It would then be obvious to convert this tree into a control flow graph as taught by Larus and then run a plurality of sample executions on the code, collecting frequency information as taught by Larus, since this is a more beneficial method for collecting frequency information. Claims 8, 12, and 17 correspond directly with Claim 4 and are rejected for the same reasons as Claim 4.

In regard to Claim 5, Buzbee teaches that his translator generates profile information by "associating counters with the branches (arc counting)" or with "code representing each line." (Column 7, lines 1-3) These counter values, being precise measurements, can be classified as EXACT values. Therefore, it is obvious to one with ordinary skill in the art at the time of the invention to use a source code optimizing compiler described by Buzbee with a tree representation of the intermediate code. It is further obvious to construct a flow graph from this tree, giving counter values to the arcs of said flow graph, and labeling these counter values as EXACT, since they represent the exact number of times certain portions of code have been

executed. Claims 13 and 18 correspond directly with Claim 5 and are rejected for the same reasons as Claim 5.

7. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Buzbee et al. (U.S. Patent Number 5,815,720) in view of Buzbee et al. (U.S. Patent Number 6,275,981) and futher in view of Dean et al. (U.S. Patent Number 6,070,009) and Gobel (U.S. Patent Number 6,139,200).

In regard to Claim 19, the combination of Buzbee (U.S. Patent Number 5,815,720), Buzbee (U.S. Patent Number 6,275,981), and Gobel teaches the method of Claim 17, but does not teach that the value annotated to the edge of the control graph is either GUESS or UNKNOWN. Dean, however, does teach estimating path frequencies based on path profiling (Column 7, lines 1-4). Since an estimation can be seen as a guess, it is obvious that "GUESS" would be one of the labels for an edge of the program's control flow graph.

8. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Buzbee et al. (U.S. Patent Number 5,815,720) in view of Dean et al. (U.S. Patent Number 6,070,009) and further in view of Gobel (U.S. Patent Number 6,139,200).

In regard to Claim 20, Buzbee teaches: (1) accessing the first intermediate representation of source code with instrumented instructions. "Annotations are placed in the first object code. The translator utilizes the annotations within the first object code to determine the particular profiling code to be placed within the second object code and thus to determine the profile information which will be generated." (Column 2, lines 20-25); (2) Annotating intermediate code with feedback data as shown in Figure 5, element 42; (3) Updating data using a propagation scheme. This is shown in Figure 5, elements 44-45, where a translator generates profile

information based on annotations; (4) Optimizing intermediate code using feedback data. "Profile information 36 is used during a second compile to produce an optimized application 38. (Column 3, lines 55-56, figure 6); (5) Repeating the updates to the propagation data and the optimization based on this feedback data to further optimize code. The "process my be repeated to generate additional profile information about the optimized object code to further optimize object code for the application." (Column 2, lines 16-18). Buzbee does not specifically teach that the feedback data annotated into the intermediate representation is estimated frequency data. Dean, however, does teach path profiling where execution frequencies of selected paths are estimated (Column 7, lines 1-4). Buzbee does teach performing multiple optimizations, but neither Buzbee Dean teach performing multiple updates and optimizations during the same compilation pass. Gobel, however, does teach performing multiple feedback data updates and optimization in a single compiler pass (Figure 5, items 540 and 570 and Column 8, lines 30-35). Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to access an instrumented source code, annotate it with feedback data, and update the data and perform optimizations of the source code multiple times, as taught by Buzbee, where the feedback data is estimated frequency data as taught by Dean, and the multiple updates and optimizations occur in one compiler pass, as taught by Gobel, since this allows for a fully optimized program on only one compilation.

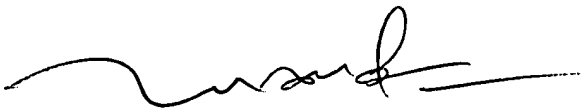
Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kenneth A Gross whose telephone number is (703) 305-0542. The examiner can normally be reached on Mon-Fri 7:30-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tuan Q Dam can be reached on (703) 305-4552. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 746-7239 for regular communications and (703) 746-7240 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-3900.

KAG
June 26, 2003



TUAN Q. DAM
PRIMARY EXAMINER